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CENTENNIALS AND POLYCENTENNIALS OF CHEMICAL INTEREST DURING 1950

ERNEST H. HUNTRESS

Massachusetts Institute of Technology
Cambridge, Massachusetts

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This paper draws to the attention of alert teachers and students of science in general and chemistry in particular certain anniversaries which occur during the year 1950 of the birth or death of certain important figures. The mode of presentation is essentially the same as in the corresponding treatment[1] for the preceding year. Attention is called to the fact that the citations accompanying most of the biographical digests indicate the location in the periodical literature of portraits and photographs of the subjects, a service not anywhere else available. These are classified as P_1, P_2, and P_3 in diminishing order of quality, the first category being reserved for full-page pictures printed on only one side of the sheet and often on special paper. Although no attempt has been made to distinguish between biographies, jubilees, obituaries, memorials or other characterizations, all being designated by B, the order in which they are listed corresponds in a diminishing sequence to the present author's opinion of their relative importance as source material.

Of the twenty-seven individuals comprising this treatment for the year 1950, nineteen are 100-year anniversaries, five are 150-year memorials, while the remaining three represent celebrations of 250, 300 and 400 years, respectively.

RED LETTER DAYS DURING 1950

——	Quadricentenary of birth of J. NAPIER
Jan. 13	Centenary of birth of C. F. MABERRY
Feb. 7	Centenary of birth of J. B. F. HERRESHOFF
Feb. 9	Sesquibicentenary of birth of D. BERNOUILLI
Feb. 11	Sesquicentenary of birth of W. H. F. TALBOT
Feb. 11	Tercentenary of death of R. DESCARTES
Feb. 13	Centenary of birth of J. W. BRÜHL
Feb. 26	Centenary of birth of J. J. HUMMEL

[1] Huntress, "Centennials, Sesquicentennials, and Bicentennials of Chemical Interest During 1949," Proc. Am. Acad. Arts Sci. 77, 35–54 (1949).

Mar. 3	Centenary of birth of Z. H. SKRAUP
Apr. 1	Centenary of birth of H. VON PECHMANN
Apr. 8	Centenary of birth of W. H. WELCH
May 9	Centenary of birth of E. WESTON
May 9	Centenary of death of J. L. GAY-LUSSAC
May 13	Centenary of birth of O. HEAVISIDE
May 29	Centenary of birth of G. GOLDSCHMIEDT
June 6	Centenary of birth of K. F. BRAUN
July 15	Sesquicentenary of birth of J. B. A. DUMAS
July 31	Sesquicentenary of birth of F. WÖHLER
Aug. 7	Centenary of birth of A. R. M. HENNIGER
Aug. 26	Centenary of birth of C. R. RICHET
Aug. 30	Centenary of birth of F. HOFMEISTER
Sept. 5	Centenary of birth of E. GOLDSTEIN
Sept. 22	Sesquicentenary of birth of J. L. LASSAIGNE
Oct. 8	Centenary of birth of H. L. LECHATELIER
Nov. 20	Centenary of birth of O. G. DOEBNER
Dec. 12	Centenary of death of G. H. HESS
Dec. 29	Sesquicentenary of birth of C. GOODYEAR

NAPIER, JOHN

Born 1550, at Murchiston, near Edinburgh, Scotland; died April 4, 1617, at Murchiston.

John, the eighth Napier of Murchiston, was born when his father, Archibald, was little more than 16 years old. John Napier matriculated at St. Salvator's College, St. Andrews University, in 1563 but did not remain there to graduate since before 1566 he departed for study in Paris, and travel in Italy and Germany. He had returned to Scotland, however, by 1571. By his first marriage (1572) he had a son and a daughter and after the death of his first wife a second marriage (1579) gave five sons and five daughters, of whom the second son, Robert, became his literary executor.

Napier as an ardent Protestant took an active part in church politics and in 1593 (4) published, under the title, "a plaine discovery of the whole Revelation of St. John," a book now regarded as of considerable importance in the history of Scottish theology, and which at the time passed through several editions in English, French, German, and Dutch. He seems next to have been occupied with various military inventions, no doubt stimulated by the generally expected invasion by Philip of Spain, for in 1596 he described a mirror for setting fire to hostile vessels, a piece of artillery for destroying everything around the arc of a circle, and a round metal chariot such that it could rapidly and

easily be moved by its occupants while firing shot out through small orifices.

In July, 1614, Napier published a volume entitled, "Mirifici Logarithmorum Canonis Descriptio," wihich contained the first description of the nature and use of logarithms (to which he gave this name), and the first logarithm table (comprising to seven figures his values of the logarithms of the sines of angles). This book was translated into English by Edward Wright, whose work was posthumously published (1618) by his son Samuel Wright. The methods by which Napier had arrived at the important results embodied in the "Descriptio," though actually written previous to it, were nevertheless first disclosed in a second book, "Mirifici Logarithmorum Canonis Constructio," published (1619) after Napier's death by his son Robert and translated (1889) into English by W. R. MacDonald.

The logarithms introduced by Napier in the "Descriptio" are not the same as those now designated as Naperian or natural logarithms, and also differ from the present common decimal logarithms. The transposition of the original logarithms to the decimal system was contemplated by Napier himself but actually first consummated by Henry Briggs, Gresham Professor of Geometry in London, who first published the results about 1617.

Napier also devised a method of multiplication and division using so-called enumerating rods later known as "Napier's bones." His name is also associated with certain aspects of spherical trigonometry and with the independent discovery of the use of the decimal point in arithmetic although it had also been employed by Pitiscus in the tables (1612) of his "Trigonometria."

An international congress held in Edinburgh in July, 1914, to commemorate the tercentenary of the publication of the "Descriptio" resulted in the publication in 1915 by the Royal Society of Edinburgh of a Napier Tercentenary Memorial Volume edited by the Society's secretary C. G. Knott. An extraordinary collection of portrait and biographical references is given in Archibald's "Mathematical Table Makers," pp. 59–63 (1948).

P_2 Ann. Rept. Smithsonian Inst. for 1914, 175–181 (1915). B Dict. Natl. Biog. *40*, 59–65 (1894).

MABERRY, CHARLES FREDERIC

Born Jan. 13, 1850, at New Gloucester, Maine; died June 26, 1927, at Portland, Maine.

Chemical training at Lawrence Scientific School of Harvard University under Josiah P. Cooke led to Mayberry's doctorate in 1876. Subsequently (1883) he became Professor at Case School of Applied

Science in Cleveland, Ohio, where he remained continuously until his retirement (1911). During this period published with a student (H. H. Dow) a paper which developed into Dow process for extraction of bromine from brine.

Maberry is best known as a pioneer in study of petroleum. These studies, which began in 1887 and continued until long after his retirement, comprised theoretical approaches to the geochemical origin of petroleum, practical investigations of lubricants and lubrications, and extensive inquiries looking to the identification of the constituents and establishment of the composition of American petroleum.

P_3B Ind. Eng. Chem. *15*, 314 (1923): Ind. Eng. Chem., News Ed. *5*, 5 (July 10, 1947): B J. Chem. Education *5*, 1117–1120 (1928): B Natl. Cycl. Am. Biog. *10*, 411 (1909): B Dict. Am. Biog. *11*, 540 (1933).

HERRESHOFF, (JOHN BROWN) FRANCIS

Born Feb. 7, 1850, at Bristol, Rhode Island, died Jan. 30, 1932, at Atlanta, Georgia.

This Anerican chemical engineer and metallurgist was the sixth and youngest son of a famous Rhode Island family. One of his older brothers, James Brown Herreshoff (March 18, 1834—Dec. 5, 1930) was a distinguished inventor; two others, John Brown Herreshoff (April 24, 1841—July 20, 1915) and Nathaniel Greene Herreshoff (March 18, 1848—June 2, 1938) became world renowned ship designers and builders. For several decades they supplied the racing yachts which defended the American Cup established (1857) as a perpetual international challenge trophy.

J. B. Francis Herreshoff attended Brown University in near-by Providence, Rhode Island, with the class of 1870. He served (1867–1868) as chemical laboratory assistant and (1869–1872) as assistant professor of analytical chemistry. Many years later Brown University awarded him successively with three honorary degrees, an A.M. (1890), Ph.B. (1905 by special vote), and eventually (1909) the D.Sc.

After several miscellaneous associations with chemical industry he was selected (1875) by William H. Nichols as superintendent of the Laurel Hill Chemical Company of Long Island, N. Y., and during the subsequent fifty years of his professional life was a pioneer in the development of sulfuric acid manufacture. During all of this period he was connected with one or another of the Nichols chemical enterprises and subsequent to their merger (1899) into the General Chemical Company served as its consulting engineer until his retirement (1924).

Mr. Herreshoff early devoted his attention to copper smelting and

invented (1883) an important type of steel-enclosed, water-jacketed smelting furnace. Soon thereafter he obtained at age 36 three American patents which substantially revolutionized the sulfuric acid industry. The first (U. S. 335,699, Feb. 9, 1886) comprised the Herreshoff tower which made possible the attainment of much higher acid concentration than previous practice. The second (U. S. 357,528, Feb. 8, 1887) represented a new process, and the third (U. S. 369,790, Sept. 13, 1887) a new apparatus for further increase in acid concentration. Still later he effected developments which established the contact process for sulfuric acid manufacture in the United States. He invented (1896) the roasting furnace for fine pyrites ores which still bears his name, was led into studies on the recovery of copper from the cinder, and developed in collaboration with W. C. Ferguson a process for removal of even minute amounts of impurities from copper. As a result of his work the Nichols companies were by 1900 producing daily 1,000,000 pounds of electrolytic copper or about one-fourth of the world's output at the time. Because of its high purity such copper was used in preference to that of Lake Superior origin in construction of the Atlantic cable.

In recognition of his great contributions to the science and technology of these important chemical and metallurgical processes Herreshoff became (1908) the first American to receive the now famous Perkin Medal of the New York Section of the (British) Society of Chemical Industry. This honor also comprised the second award of this medal which had been established (1906) in honor of Sir William H. Perkin, himself its first recipient.

P_3B Ind. Eng. Chem. *19*, 1205–1206 (1927): P_3B Electrochemical and Metallurgical Industry *6*, 51–54 (1908): B J. Soc. Chem. Ind. *27*, 265–271 (1908): P_3B Ind. Eng. Chem., News Ed. *10*, 29 (1932): P_1B Natl. Cycl. Am. Biog. *24*, 96 (1935).

BERNOUILLI, DANIEL

Born Feb. 9, 1700 (New Style) at Gröningen, Netherlands; died March 17, 1782, at Basel, Switzerland.

The Swiss Bernouilli family, which in three generations produced eight mathematicians, had no fewer then 120 descendants of whom none was a failure and the majority achieved distinction, sometimes amounting to eminence in various fields. Daniel, a son of Johann Bernouilli (1667–1748), is said to have begun at 11 the study of mathematics under the tutelage of his brother Nicolaus III, only five years older than himself. Although pressed by his father to enter business, Daniel first studied medicine, yet accepted (1725–1733) a mathematical post at the Russian Academy in St. Petersburgh.

Irked, however, by the comparative barbarity of life in Russia, he returned to Switzerland, where at the University of Basel as professor of anatomy and botany (1733–1750) and later of physics and natural philosophy (1750–1777) he spent 44 years, finally with advancing years resigning in favor of his brother's son, Daniel Bernouilli the younger.

Daniel Bernouilli is regarded as the father of mathematical physics. His interests included the calculus, differential equations, theory of probability, theory of vibrating strings, and the kinetic theory of gases. His principal work was the "Hydrodynamica" (1738) in which, based on a recognition of the principle of the conservation of energy, he considered from both theoretical and practical viewpoints the behavior of fluid flow and formulated the theorem of fluid pressure which still bears his name.

He won no less than ten prizes from the French Academy of Sciences, including at least one for which his father also competed, and was elected (1750) to the Royal Society of London.

TALBOT, WILLIAM HENRY FOX

Born Feb. 11, 1800, at Melbury, Dorsetshire, England; died Sept. 17, 1877, at Lacock Abbey, near Chippenham, Wiltshire, England.

This British country gentleman received his education at Harrow (1811–1815) and at Trinity College, University of Cambridge, where he attained B.A. (1821) and M.A. (1825). His subsequent work in photography has rather obscured his earlier accomplishments in mathematics, physics and astronomy but these were sufficient to cause his election (1831) at age 31 to the Royal Society of London. He was with Rawlinson and Hincks one of the earliest to decipher the Assyrian cuneiform inscriptions at Nineveh. He was for two years (1832–1834) a member of Parliament and throughout his life an extensive traveler. A monument to his memory has been erected on his estate at Lacock Abbey [Phot. Korr. *58*, 236 (1912)] and a collection of his apparatus has been presented to the Museum of the Royal Photographic Society in London.

His chief contribution to science, however, was the series of discoveries which established photography in the modern sense. The first of these (1834) was the production of photographic images on paper impregnated with silver chloride. The idea of this process was conceived in October, 1833, during a visit to Lake Como in Italy as a result of his attempts to record the scenery on transparent paper in the camera obscura. Upon his return to England he conducted extensive experiments (1834–1835) which led to his first pictures. Meantime others were active in the field, especially the French Daguerre, who

had (1833) made the discovery that a latent image on silver iodide could be developed to a picture by exposure to mercury vapor. A rumor of Daguerre's work caused Talbot to have his process of "photogenic drawing" expounded by Faraday before the Royal Institution on January 25, 1839, and Talbot himself did so before the Royal Society of London on January 31, 1839. A full description of the process was published [Phil. Mag. (3) *14*, 196–211 (1839); Proc. Roy. Soc. London *4*, 120–121, 124–126, 134 (1839)] in the same year.

In the following year (1840) Talbot made another epochal advance by his discovery that the use of silver iodide (rather than silver chloride) enormously increased the sensitivity and speed of formation of the latent image, that it could be developed with gallic acid, and that the resultant image could be fixed with potassium bromide solution [Proc. Roy. Soc. London *4*, 312–316 (1841)]. These operations led to the production of a negative from which any desired number of positive prints could subsequently be made. Talbot himself referred to such prints as "calotypes" (beautiful pictures) but they were also designated as "Talbotypes"; for their invention Talbot received (1842) the Rumford Medal of the Royal Society. His book, "The Pencil of Nature" (1844), became the first publication to be illustrated by photography, this term having been sanctioned through its use by Talbot's friend, Sir John Herschel, in a lecture of March 14, 1839, to the Royal Society.

A decade later (1852) Talbot discovered that after treatment with dichromate, gelatin becomes insoluble upon exposure to light, utilized this characteristic in protecting steel and copper plates from the action of suitable etching solutions, and thus obtained photoetchings suitable for intaglio printing.

Talbot took out patents on all his inventions and vigorously prosecuted all infringements. These severe measures were not helpful to the advancement of photographic science and Talbot was eventually persuaded to open the patents to free public (but not commerical) use.

In addition to the journal publications cited below, an extraordinary wealth of detail regarding Talbot's work can be found in Eder's "History of Photography," English translation (1945) by E. Epstean of the fourth (1932) German edition.

P_2B Phot. J. *87-A*, 3–13 (1947); *74*, 427–433, 435 (1934): P_2B J. Chem. Education *4*, 306–308 (1927); *9*, 1414–1415 (1932): B Nature *133*, 977–978 (1934): B Z. wiss. Phot. *31*, 324–326 (1933): B Phot. J. *77*, 307–313 (1937): B Proc. Roy. Soc. Edinburgh *9*, 512–514 (1878): B Phot. J. *61*, 440–446 (1921): B Phot. J. *64*, 521–524 (1924): B Dict. Natl. Biog. *50*, 339–341 (1898).

DESCARTES, RÉNÉ DUPERRON

Born March 31, 1596, at La Haye, Touraine, France; died Feb. 11, 1650, at Stockholm, Sweden.

This ancient French philosopher, mathematician and physicist whose Latin name of Renatus Cartesius leads to the term Cartesian, was a prodigious traveler but did most of his productive work (1628–1648) in Holland.

Those aspects of this versatile philosopher of most interest to scientists concern his work in mathematics, physics and physiology. He attempted to reduce all science to a kind of applied mathematics or mechanics and has been described as the first modern mathematician. In his "Geometry" (1637) he laid the foundations of analytical geometry. He was the first to attempt a systematic classification of curves and distinguished between "geometric" and "mechanical" varieties, terms which Newton later displaced by "algebraic" and "transcendental." His algebraic work involved the geometric interpretation of negative quantities, led to the concept of continuity and thus to the theory of functions and limits. He first devised the convention of employing the first letters of the alphabet to represent known quantities and the last letters to signify unknowns, and also introduced the use of exponents.

In his books on "The World" and "Principles of Philosophy" Descartes attempted an explanation of the genesis of the physical world and evolved his famous vortex or whirlpool theory. He rejected the corpuscular theory of light and conceived its transmission as pressure from the luminous body, thus preparing the way for the undulatory theory of Huygens. In his "Dioptrics" he published (1637) for the first time the law of refraction of light discovered (1621) but not reported by Snell. He accounted for the formation of multiple rainbows but the explanation of their colors remained for Newton.

His studies on physiology were posthumously published (1662) in "L'Homme" which may be considered the first textbook of physiology.

In 1649 he was invited to Stockholm to instruct the Swedish queen, Christina, in his philosophy. Required by courtesy to accede to her eccentric preference for discussion thrice a week at 5 o'clock in the morning, and harassed by the severity of the northern winter, he developed pneumonia which soon proved fatal. His remains were eventually transferred to France and deposited (1819) in the church of St. Germain du Prés.

The 13 quarto volumes "Oeuvres de Descartes," published 1897–1911 in Paris, include one biographical section (Vol. 12) by C. Adam; there is also in English the work of Elizabeth S. Haldone on "Descartes, His Life and Times," (1905).

B Science Progress *21*, 457–478 (1926–7): B Pop. Sci. Monthly *37*, 833–840 (1890).

BRÜHL, JULIUS WILHELM

Born Feb. 13, 1850, at Warsaw, Poland; died Feb. 5, 1911, at Heidelberg, Germany.

This Polish chemist of Jewish parentage spent most of his professional life in Germany. After study (1868–1870) at Zurich and (1870–1873) in Berlin under A. W. Hofmann in chemistry and G. Quincke in physics he was recommended for an appointment in the newly founded University of Tokyo but preferred to remain in Germany, where his friends included Döbner, Losanitch, Pinner, Tiemann, and Willgerodt. For a six year period (1873–1879) he became assistant to Landolt in the Polytechnikum at Aachen (Aix-la chapelle) (where he began the studies of optical refraction which later dominated his work), meantime obtaining (1875) his doctorate from the University of Göttingen. After a brief period (1879–1884) as professor of chemistry at the Polytechnikum of Lemberg (Lwow) in his native Poland, he was forced by the climate to seek another post and was persuaded by Bunsen to take over at Heidelberg the vacancy left by the departure of Bernthsen to the BASF laboratories at Ludwigshafen. Here he remained (1889–1908) with the title of honorary professor.

Brühl's principal contribution to chemistry was his exhaustive and protracted series of researches on the relations between refractivity and chemical constitution of organic compounds. Subsequent to the pioneering work of Gladstone and Dale in England, Brühl became the chief authority in this branch of science. By 1880 he had recognized that the mode of linking of its constituent atoms was determinative in the optical refraction of organic molecules and thus placed at the disposal of science an important new tool in the establishment of organic structures. He was the first to bring optical evidence to bear on the question of constitution of the benzenoid nucleus. In a lecture to the Royal Institution [Proc. Roy. Institution *18*, 122–135 (1905)] Brühl himself has reviewed the development of what he called "spectrochemistry." Brühl spoke and wrote in German, Polish, Russian, French, English and Italian and continued with the help of Hjelt and Aschan the publication of the organic section of the great chemical treatise of Roscoe and Schorlemmer by two important volumes on the chemistry of 5-membered (1898) and 6-membered (1899) heterocyclic systems.

P_1B Ber. *44*, 3757–3794 (1911) (incl. bibliog.): B Am. Chem. J. *45*, 536–537 (1911): B Nature *85*, 517–518 (1911): B J. chim. phys. *9*, 502 (1911).

HUMMEL, JOHN JAMES

Born Feb. 26, 1850, at Clitheroe, Lancashire, England; died Sept. 13, 1902, in Scotland.

This British pioneer teacher of the art and science of dyeing was of Swiss descent, and received his technical education (1867–1869) at the Zurich Polytechnic under Städeler, Bolley, Wislicenus and Weith. The next decade was absorbed by various industrial connections, first (1869–1875) at the Dalmonach Works of James Black and Company at Alexandria, near Glasgow, Scotland, next (1876) as submanager of the Foxhill Bank Print Works at Church, Lancashire, England, then (1877–1878) as a managing partner in the Alexander Print Works, Milngavie, near Glasgow, and finally (1878–1879) at the Nethercoal Dyeworks, Auchterarder, Perthshire, Scotland. This practical experience proved invaluable for at this juncture the Clothworkers Company of the City of London established at Yorkshire College in Leeds a school of dyeing of which Hummel became the head (1880–1902) for the rest of his life.

Yorkshire College of Science was founded in 1874 with three chairs, viz., chemistry, physics and mathematics, geology and mining. To these, departments of biology and of engineering were added in 1876, and when in the following year the teaching of classics, literature and history was added, the institution became Yorkshire College. A decade later (1887) the college was admitted to Victoria University and finally (1904) obtained a separate charter becoming the present University of Leeds.

Hummel's instruction in dyeing began (1880) with about 18 students in primitive accommodations but was so popular and successful that by 1885 it occupied new buildings with special equipment built to Hummel's design. By 1890 its superior training and facilities had become widely recognized and attracted students not only from all parts of the United Kingdom but also from Belgium, Brazil, Canada, France, Germany, India, Japan, and Spain. In this year there was added to its teaching functions special provision for regular systematic research in dyeing and tinctorial science which was actively utilized by Hummel and after his death continued (1903–1916) by A. G. Green and (1916–1926) by A. G. Perkin both of whom had been Hummel's students and (1926–1946) by F. M. Rowe.

Hummel's research achievements were naturally in the chemistry of coloring matters and in problems of dyeing. The former were largely concerned with natural coloring matters containing derivatives of anthraquinone. Of the latter the most outstanding were his development of the process for dyeing and printing basic colors on tannin-

antimony-mordanted cotton and later his work on the chrome mordanting of wool. His principal literary work was the classical "Dyeing of Textile Fabrics" (1885), the first of modern texts in this special field. This went through nine editions in English and was also translated into German, French, Italian, and Japanese. Hummel also wrote many special articles for technical dictionaries and encyclopedias.

B J. Soc. Dyers and Colourists *55*, 14–30 (1939) (incl. bibliog.): B J. Chem. Soc. *83*, 652–654 (1903): B J. Soc. Chem. Ind. *21*, 1176–1177 (1902): B Nature *66*, 520 (1902): B Ber. *35*, 3364 (1902).

SKRAUP, ZDENKO HANS

Born March 3, 1850, at Prague, Bohemia (now Czechoslovakia); died Sept. 10, 1910, at Vienna, Austria.

This distinguished organic chemist received his early education (1866–1871) at the Prague Technische Hochschule, following which he was briefly employed in a Karlsbad stoneware and porcelain factory and at the mint whose director at this period was Schrötter, the discoverer of red phosphorus. In 1873 Skraup entered the University of Vienna where he served as assistant to Rochleder and after the latter's death continued with A. Lieben. Following a not uncommon European practice of the time, he passed his doctoral examinations (1875) at the University of Giessen but continued for some years at Vienna. Subsequently he taught at various places including (1881–1886) the Vienna Handelsakademie and the University of Graz. For two decades (1887–1906) he occupied the chair of chemistry at the Graz Technische Hochschule but spent the last four years (1906–1910) of his life at the University of Vienna as successor to the retired Lieben, who nevertheless outlived Skraup by four years.

Skraup's name is, by contemporary students of organic chemistry, most frequently associated with his discovery [Monatsh. *1*, 316–318 (1880)] and development of the well-known quinoline synthesis which bears his name. Less generally known, however, is his determination of the composition of the pigment known as soluble Berlin blue and his resolution of the relationships between ferrous ferricyanide and ferric ferrocyanide. Rochleder had also interested Skraup in the study of cinchona alkaloids and these researches were extensively pursued. Skraup first established (1878) the empirical formulas of cinchonine and cinchonidine and proved (1880) the structures of cinchoninic acid (quinoline-4-carboxylic acid) and cinchomeronic acid (pyridine-3,4-dicarboxylic acid).

Skraup also pioneered in the field of carbohydrates and with J. König [Monatsh. *22*, 1011–1036 (1901); Ber. *34*, 1115–1118 (1901)] was the first to obtain the disaccharide cellobiose from the polysac-

charide cellulose. He introduced [Monatsh. *26*, 1415–1472 (1905)] a new chemical method for the determination of minimum molecular weights of polysaccharides such as starch, glycogen and cellulose, based upon their reaction with acetic anhydride and hydrogen chloride and subsequent determination of the chlorine content of the product.

P_1B Ber. *43*, 3683–3702 (1910): P_3B Oesterr. Chem. Ztg. *13*, 245–252 (1910) (incl. bibliog.): P_3B J. Chem. Education *20*, 471–473 (1943): P_3B Chem. Ztg. *34*, 1013–1014 (1910): B Ber. *43*, 2782–2783 (1910): B Oesterr. Chem. Ztg. *13*, 228–229 (1910).

PECHMANN, HANS VON

Born April 1, 1850, at Nürnberg, Germany; died April 19, 1902, at Tübingen, Germany.

This German master of organic synthesis published his first paper at age 29, followed it with a flood of fundamental discoveries for the next two decades, then at age 52 became the victim of self-administered cyanide.

After early college training (1869–1871) at the University of Munich interrupted by a summer semester at Heidelberg (1870), Pechmann completed his professional training at the University of Greifswald in German Pomerania taking his doctorate (1875) under Limpricht with a thesis on the "Sulfonic Acids of p-Toluidine." Following a summer at Geneva and two years (1875–1877) with Sir Edward Frankland in London, he embarked upon his creative career under A. von Baeyer at Munich, serving first in the elementary section of the organic division and later (1885) as assistant professor of analytical chemistry. The last seven years of his life were spent at the University of Tübingen, where as associate professor of general chemistry he succeeded Lothar Meyer.

Pechmann's contributions to the advancement of organic chemistry embraced so wide an area that only a few may be mentioned here. His first paper from the Munich laboratory [Ber. *12*, 2124–2129 (1879)] established the symmetrical structure of anthraquinone, a result simultaneously but quite independently achieved by C. Loring Jackson [Ber. *12*, 1965–1967 (1879)] through a different approach. Together with Carl Duisberg he synthesized [Ber. *16*, 2119–2128 (1883)] β-methylumbelliferone (7-hydroxy-4-methylcoumarin) by condensation of ethylacetoacetate with resorcinol and developed the important general procedure of substituted coumarins still designated as the von Pechmann-Duisberg method. This was closely followed [Ber. *17*, 929–936 (1884)] by a second general coumarin synthesis based upon condensation of phenols with malic acid in the presence of sulfuric acid and commonly known as the von Pechmann coumarin synthesis, the

development of which included the first artificial preparation of daphnetin (7,8-dihydroxycoumarin). He discovered [Ber. *17*, 936–938 (1884)] and named coumalinic acid (2-pyrone-5-carboxylic acid) and made extensive studies of the conversion of such compounds to pyridine derivatives. He was the first [Ber. *17*, 2542–2543 (1884)] to prepare acetonedicarboxylic acid and to make a comprehensive study [Ann. *261*, 151–208 (1890)] of its behavior. He first prepared 1,2-diketones, e.g. biacetyl [Ber. *20*, 3162–3164, 3214 (1887)]. He first prepared methylglyoxal [Ber. *20*, 2541–2544, 3213–3214 (1887)] and diphenyltriketone [Ber. *22*, 852–853 (1889); *23*, 3375–3387 (1890)]. He discovered [Ber. *21*, 2751–2762 (1888)] the class of osotriazoles and simultaneously but independently of Bamberger the formazyl compounds [Ber. *24*, 3255–3260 (1891)]. He was the first [Ber. *27*, 1888–1891 (1894); *28*, 2375 footnote 3 (1895)] to prepare diazomethane and to supply directions [Ber. *28*, 855–861 (1895)] for its preparation from ethyl *N*-nitroso-*N*-methylcarbamate ("nitrosomethylurethane").

P_1B Ber. *36*, 4417–4511 (1903): B Ber. *35*, 1581–1582 (1902): B Z. Angew. Chem. *20*, 1965, 2017–2019 (1907).

WELCH, WILLIAM HENRY

Born April 8, 1850, at Norfolk, Connecticut; died April 30, 1934, at Baltimore, Maryland, age 84.

This dean of American medicine, scholar, educator and administrator was professionally pathologist, bacteriologist and physician, but his influence on medical education and research was profound and his career of intense interest to chemists. Welch was an only child in a family with a deep and wide medical background. His father, four uncles, grandfather and great grandfather were all physicians. After college training (1866–1870) at Yale University, and a year in teaching Latin and Greek at Norwich, N. Y., he seriously embarked on his professional career at the Columbia University College of Physicians and Surgeons (1872–1875) where his M.D. thesis on goitre won first prize. He spent the next three years in Europe including study at Strasbourg with Waldeyer (histology), von Recklinghausen (pathology), Hoppe-Seyler (biochemistry), at Leipzig with Ludwig (physiology) and Wagner (pathology), at Breslau with Cohnheim (pathology) and at Prague, Vienna, Paris and London with other distinguished scientists. Upon his return to America he became (1878–1884) lecturer in pathology at New York City's Bellevue Hospital Medical College and established the first pathological laboratory in the United States.

The last 50 years of his long life divide into three somewhat overlapping phases. The first (1884–1916) and longest began with his appointment as professor of pathology at Johns Hopkins University in

Baltimore, Maryland. Here his researches included the discovery of the gas-producing bacillus (Bacillus welchii) responsible for "gas gangrene" and the development of many other pathological advances. During his tenure the establishment (1889) of the Johns Hopkins Hospital and later (1893) the Johns Hopkins Medical School increasingly diverted him from strictly laboratory duties and utilized his special abilities in the promotion of medical education and general public health activities. Welch himself served (1893–1898) as first dean of the medical school and was instrumental in bringing to the new enterprise Osler in medicine, Halsted in surgery, and Kelly in gynecology, this famous group comprising Sargent's (1905) well-known painting of "The Four Doctors." During this period Welch also founded (1896) the Journal of Experimental Medicine, the first scientific medical journal in the United States and himself served as editor for its first decade. The Rockefeller Institute for Medical Research was organized (1910) in a way largely based on Welch's advice and he long served (1901–1934) as chairman of its board of scientific directors.

The second period of Welch's life (1917–1926) was devoted to the foundation and development of the Johns Hopkins School of Hygiene and Public Health, made possible by the Rockefeller Foundation with Welch as its first director.

In 1926 Welch entered (at age 76) upon a third career in the organization of the Johns Hopkins Institute of the History of Medicine, a project envisaged by him as early as 1888, finally brought to fruition by an endowment from the General Education Board, and since 1929 containing the Welch Memorial Medical Library [see Sci. Monthly *29*, 280–285 (1929)].

Dr. Welch was elected (1895) to the National Academy of Sciences, later (1913–1917) followed Ira Remsen as its president, and was a leader in the foundation of the National Research Council. He served as president of many national professional organizations and was the recipient of many honors from both American and foreign institutions. On his 80th birthday he participated in a celebration unique in the history of tributes paid to a scientist. The speakers included the President of the United States (Herbert Hoover) and the exercises were carried by radio to simultaneous celebrations in other American cities, Europe and Asia. [For a full account see "William Henry Welch at Eighty—A Memorial Record of Celebrations Around the World in His Honor," a volume of 230 pp. edited by V. O. Freeburg and published in 1930]. An authoritative biography by Simon Flexner and James Thomas Flexner was published in 1941 by the Viking Press of New York.

P_1B Biog. Memoirs, Natl. Acad. Sci., U. S. *22*, 215–231 (1943)

(incl. bibliog.): B Science *79*, 529–533 (1934); *52*, 417–453 (1920); P_3B J. Am. Med. Assoc. *102*, 1513–1514 (1934): B Proc. Am. Acad. Arts Sci. *70*, 596–599 (1934–5): B Nature 133, 786 (1934); P_2B Sci. Monthly *23*, 87 (1926); *29*, 280–285 (1929); *30*, 472–473 (1930): *38*, 579–581 (1934): B J. Chem. Education *6*, 1283 (1929): B Am. Dict. Biog. *19*, 621–624 (1936): P_1B Dict. Natl. Biog. *26*, 6–8 (1937).

WESTON, EDWARD

Born May 9, 1850, at Brynn Castle near Oswestry, Shropshire, England (150 miles northwest of London); died Aug. 20, 1936, at Montclair, N. J., age 86.

Weston's parents intended him for medicine but after three years as medical apprentice he abandoned this pursuit for science. Intrigued by the accounts of an American tourist he came (1870) to the United States and after a brief period with a New York manufacturer of photographic chemicals was employed (1871) by the American Nickel Plating Company. Here he invented a method for depositing nickel in such a fashion that it was afterwards malleable. The next year he formed his own electroplating company and built (1872) the first successful dynamo as a substitute for batteries in the commercial electrodeposition of metals. He established (1875) in Newark the first American factory exclusively devoted to the manufacture of dynamos and electrical machinery. During both this early period and a subsequent connection (1881–1888) following consolidation of his firm with the U. S. Electric Lighting Company, lack of methods for precise and convenient electrical measurements compelled him to design and produce new devices for this purpose. This led to his foundation (1888) at Newark, N. J., of what is now the Weston Electric Instrument Corporation.

Weston was a prolific inventor and at the time of his death his 309 patents ranked 8th in the list of living American inventors. He developed and produced (1888) the first moving coil direct reading ammeters and voltmeters. He invented both constantan and manganin (1889), alloys with very low temperature coefficients of electrical resistance. In 1877 he mounted a carbon arc lamp at the corner of Newark's Washington and Market Streets, the first public exhibition of arc lighting in the United States. He was responsible for numerous developments in underground cables, distributing systems, switches, meters and circuit indicators, air pumps, safety fuses and light fixtures. He invented a new filament (Tamadine) for incandescent lamps which constituted their most important advance prior to the arrival of the tungsten filament. Other inventions included a compensated thermocouple instrument for high frequency measurements, the rectifier

bridge for a.c. measurements, and the first commercially practical dry disk photoelectric cell. Weston was also the first (1910) to make use of the synthetic resin Bakelite on a commercial scale in the electrical industry.

In 1892 Weston devised a new type of standard cell employing cadmium and mercury as its fundamental elements. This cell was subsequently (1908) adopted by the International Electric Commission as the official standard of electromotive force, after which Weston opened his patents on it for public use. This cell has at 20° an E.M.F. of 1.0183 international volts and is the most accurate and convenient of all practical electrical standards. [For directions on preparation of such cells by students see J. Chem. Education *18*, 87–89 (1941); for a survey of this and early E.M.F. standards see Trans. Am. Electrochem. Soc. *68*, 133–150 (1935)].

A charter member of the American Institution of Electrical Engineers (founded 1884) he was honored as its president (1888–9) and vice president (1889–1891) and awarded its Lamme medal in 1932. Other recognitions included the Franklin medal (1924) of the Franklin Institute, the Perkin Medal (1915) of the Society of Chemical Industry (American Section), and honorary degrees from MeGill (LL.D. 1903), Stevens Institute of Technology (Sc.D. 1904), University of Pennsylvania (LL.D. 1924), and Princeton University (Sc.D. 1910).

P_2B Ind. Eng. Chem. *7*, 243–254 (1915): P_2B Trans. Am. Electrochem. Soc. *70*, 30–32 (1936): P_2B Trans. Am. Electrochem. Soc. *55*, 17–21 (1929): B ibid. *50*, 3–5 (1926): Trans. Am. Inst. Elec. Engrs. *55*, 1049 (1936): B Nature *138*, 496 (1936): B Natl. Cycl. Am. Biog. *5*, 176 (1907): B J. Sci. Instruments *13*, 343 (1936).

GAY-LUSSAC, LOUIS JOSEPH

Born Dec. 6, 1778, at St. Leonard, a small town near Limoges in the ancient province of Limousin, Department Haute-Vienne, France; died May 9, 1850, at Paris.

Gay-Lussac, one of the great chemists of all time, was concerned with physical, inorganic, organic, analytical and industrial chemistry. The reader must understand that the following text can do no more than suggest a few interesting aspects of his career.

For three years (1797–1800) Gay-Lussac studied at the École Polytechnique in Paris; here he became acquainted with Thenard, later his life-long collaborator. Thence he went to the École des Ponts et Chausées as assistant to Berthollet, then just over 50 at the height of his distinguished career. In 1802, without giving up his position with Berthollet, Gay-Lussac rejoined the École Polytechnique, where as assistant professor he sometimes lectured for Fourcroy. In 1809 he

became professor of both chemistry and physics at the Sorbonne, resigning in 1832 for the chair of chemistry at the Jardin des Plantes.

In pursuit of an investigation of terrestrial magnetism, Gay-Lussac at age 26 made two balloon ascensions. The first, made on Aug. 24, 1804, in company with his fellow physicist Biot [see P_3 J. Chem. Education *9*, 1391 (1932)] reached a height of 4000 meters. The second which Gay-Lussac made alone to reduce the weight to be lifted, attained on Sept. 16, 1804, 7016 meters (23,000 feet) [see P_3 J. Chem. Education *12*, 108 (1935)], up to that time the greatest height achieved by man. From samples taken on these ascents, Gay-Lussac established the constancy of composition of the air over this range.

Two fundamental principles discovered by Gay-Lussac are still studied today by every student of chemistry. The first, frequently designated as Gay-Lussac's law, refers to the equal thermal expansion of gases. This principle was first recorded [Ann. chim. (1) *43*, 137–175 (1802)] by Gay-Lussac, although it had been foreshadowed by earlier (1787) but unpublished work of J. A. C. Charles; this fact was meticulously recognized in Gay-Lussac's paper [cf. photograph of page 157 of Gay-Lussac's paper in J. Chem. Education 11, 351 (1934)]. The generalization is, therefore, sometimes called the law of Charles and Gay-Lussac. The second great principle (1808) was the law of combining volumes; i. e., that when substances react in the gaseous state the volumes both of reactants and products stand in the relation of small whole numbers.

The more definitely chemical work of Gay-Lussac, largely in collaboration with Thenard, was very extensive. They established (1809) [Ann. chim. (1) *73*, 229–253 (1910)] the elementary nature of sulfur, determined (1813) that hyposulfites represent a state of oxidation below that of sulfurous acid, and gave the name hyposulfurous acid. Following Courtois' discovery (1811) of iodine, Gay-Lussac and Thenard made a brilliant investigation of its behavior [Ann. chim. (1) *91*, 5–160 (1814)], which included proof of the elementary nature of iodine, and the first preparation of ethyl iodide (from ethyl alcohol and hydriodic acid). With Liebig, who had been introduced to him by their mutual friend von Humboldt, Gay-Lussac prepared hydrogen cyanide (prussic acid) [Ann. chim. (1) *77*, 128–133 (1811)], showed that the CN group behaved as a unit (foreshadowing the Berzelius theory of radicals), obtained and gave the name to cyanogen and first manufactured cyanogen chloride. With Liebig he also carried out a study of fulminic acid [(Poggendorf's) Ann. Physik. *1*, 87–116 (1824)] which included determination of the composition of silver fulminate, now regarded as a sensitive detonator. With Thenard, Gay-Lussac discovered (1808) the amides and later (1810) the peroxides of both sodium and potassium.

Independently of but simultaneously with Döbereiner, Gay-Lussac introduced the use of copper oxide as the active agent in the combustion analysis of organic compounds and first employed copper filings to decompose during the analysis of nitrogen compounds any adventitious oxides of nitrogen; organic chemists also derive from Gay-Lussac [Ann. chim. (2) *46*, 113 (1831)] the name racemic acid [cf. Nature *140*, 22–23 (1937)].

Gay-Lussac may be regarded as the originator of volumetric analysis for in place of the cupellation method universally employed up to his time, he introduced a method for the determination of silver by titration with salt solution. In 1827 he devised a method for the recovery of oxides of nitrogen otherwise lost during the old lead chamber process for the manufacture of sulfuric acid, the industrial version of his apparatus being still designated as the Gay-Lussac tower.

Gay-Lussac became a member of the French Academy of Science in 1806, and was elected (1815) a foreign member of the Royal Society of London at the same time as his friends Biot and von Humboldt.

P_3B J. Chem. Education *11*, 353 (1934); *9*, 1389 (1932); *8*, 1301–1303 (1931): B Ann. Rept. Smithsonian Inst. *31*, 138–172 (1876): B Proc. Roy. Soc. London *5*, 1013–1023 (1843–1850).

HEAVISIDE, OLIVER

Born May 13, 1850, in Camden Town, London; died Feb. 3, 1925, at Torquay, Devon, England.

This self-educated British mathematical physicist and nephew of Sir Charles Wheatstone, in consequence of increasing deafness, withdrew at age 24 from most business and social contacts to his home in Torquay. Here as a recluse he lived in austerity, cooked his own food, suffered from indifferent health, and drew designs for the electrical scientists of the next and subsequent generations. Despite his election (1891) to the Royal Society and his selection (1921) as the first recipient of the distinguished Faraday medal of the Institution of Electrical Engineers, he never attended the meetings of either, and the medal was personally delivered to him at Torquay by the Institution's president. Despite these eccentricities, he sustained an extended scientific correspondence with Fitzgerald, G. F. C. Searle and Sir Oliver Lodge.

Between 1873–1892 he attempted to communicate to appropriate technical journals a large number of important papers; their significance, however, was not appreciated and the rejection of some of them deeply grieved and, to some extent, embittered their author. In 1892 he collected these into two volumes of "Electrical Papers," where their integration facilitated recognition of their merit. The three volumes of his "Electromagnetic Theory" appeared gradually (1893—1899—1912).

Heaviside first recognized (1873) the practicability of duplex and quadruplex telegraphy, was the first (1884) to solve the problem of the high-frequency resistance and inductance of a concentric main, and the first to express the theory of steady rectilinear motion of an electric charge through the ether. From a practical viewpoint his most important work was the creation of the foundation of modern theory of telephonic transmission. He suggested (1902) the probable existence of the region of ionized air considered responsible for the transmission of radio waves around the curvature of the earth now known as the Heaviside (or Kennelly-Heaviside layer).

For consideration of Heaviside as a humorist [J. Franklin Inst. *241*, 435–440 (1946)] and as seen in his books and letters [Technology Review *35*, 214, 234 (1933)] see the indicated references.

P_3B Electrician *94*, 186 (1925): B Electrician *94*, 174–175 (1925): B J. Inst. Elec. Engrs. *60*, 409–410 (1922): Nature *115*, 237–238 (1925): Proc. Am. Acad. Arts Sci. *70*, 544–545 (1934–5): B Dict. Natl. Biog. *1922–30*, 412–414 (1937).

GOLDSCHMIEDT, GUIDO

Born May 29, 1850, in Trieste, Austria; died Aug. 6, 1915, in Vienna, Austria.

This distinguished Austrian organic chemist studied (1869–1871) at the University of Vienna with Redtenbacher and Schneider, obtained his doctorate (1872) at Heidelberg under Bunsen and concluded his professional preparation by two years (1872–1874) at the University of Strasbourg under von Baeyer. After a long (1874–1891) stay in various capacities at the University of Vienna he succeeded Maly at the German University of Prague (1891–1911), subsequently returning to the University of Vienna (1911–1915) to succeed Skraup. Very early in his career (age 26) he visited the United States, travelling as far west as San Francisco and acting as official Austrian representative at the Philadelphia Exposition of 1876.

Goldschmiedt's work in organic chemistry embraced a wide variety of topics including alkaloids, polynuclear hydrocarbons, aldehyde condensations, etc. His greatest contribution is generally regarded as the establishment (1888) of the structure of the opium alkaloid papaverine as 1-(3,4-dimethoxybenzyl)-6,7-dimethoxyisoquinoline. This achievement was noteworthy not only for its own value but also because the compound represented both the first complicated oxygenated alkaloid whose structure was fully elucidated and the first recognition in an alkaloid of the isoquinoline nucleus.

Goldschmiedt was also the first (1875) to show that both oleic and claidic acids hydrogenate to stearic acid and similarly that erucic and

brassidic acids reduce to behenic acid. Goldschmiedt shares with Fittig and Gebhard the credit for the isolation and recognition (1877) of the polycyclic hydrocarbon fluoranthene. He had isolated from the residues ("Stuppfett") of the distillation of natural mercury ores at Idria in the Italian province of Goriza a new hydrocarbon for which he suggested [Ber. *10*, 2022–2030 (1877)] the name "idryl." Concurrently but independently, however, Fittig and Gebhard [Ber. *10*, 2143–2144 (1877); Ann. *193*, 142–160 (1878)] isolated from coal tar a hydrocarbon which they named fluoranthrene (now shortened to fluoranthene) and which eventually proved to be identical with Goldschmiedt's idryl.

P_1B Ber. *49*, 893–932 (1916) (incl. bibliog.): B Chem. Ztg. *39*, 649–650 (1915): B Oesterr. Chem. Ztg. *18*, 145–148 (1915).

BRAUN, (KARL) FERDINAND

Born June 6, 1850, at Fulda, Hesse, Germany; died April 20, 1918, in Brooklyn, N. Y., U. S. A.

This German physicist, inventor of the cathode ray oscillograph now familiar even to laymen because of its indispensability to television receivers, was educated at the Universities of Marburg and Berlin. After attaining his doctorate (1872) under G. H. Quincke with a dissertation on the vibration of elastic rods and strings, he spent several years as Quincke's assistant at Würzburg. He then served successively as professor of physics at Marburg (1876), Strasbourg (1880), the Technische Hochschule at Karlsruhe (1883), and Tübingen (1885), finally returning for the rest of his academic career (1895–1914) to the University of Strasbourg as Director of the Physical Institute. In 1914 he came to America to testify in a patent suit, was interned when the United States entered World War I, and died in Brooklyn seven months before the conflict ended. Eventually his ashes were returned to his native town of Fulda and buried beside those of his parents.

Braun's earlier work included substantial contributions to physical chemistry. He correctly determined (1878) a method for computing electromotive force from thermal data and was the first to study the relation between electromotive potential and pressure in galvanic cells. He discovered (1891) a new capillary electrolytic phenomenon to which he gave the name *electrostenolysis*. He first recognized the relation between the solubility of solids and external pressure and formulated it on a thermodynamic basis.

His later work was largely devoted to electrical aspects of physics. He devised an ingenious, simple and convenient high-tension electrometer still known by his name. He invented (1897) and described [(Wiedemann's) Ann. Physik *60*, 552–559 (1897)] the "Braun tube,"

now both scientifically and popularly known as the cathode ray oscillograph [for special celebration of its 50th anniversary see Naturwissenschaften *35*, 33–38 (1948)]. He succeeded (1904) in producing with ordinary light waves certain effects earlier achieved by Hertz electrically, thus first supplying evidence that light consists of electrical waves. He discovered (1874) unipolar conductivity (rectification) of certain crystals and was first (1899) to apply it in the crystal detector for wireless signals. He pioneered (1902) in the directional transmission and reception of radio communication and devised the so-called closed circuit for radio transmission and reception. In recognition of his services in the development of wireless telegraphy Braun received jointly with G. Marconi the 1909 Nobel Prize in physics.

P_1B Naturwissenschaften *16*, 621–626 (1928): P_3B Elec. Commun. *25*, 319–327 (1948): P_3B Physik. Z. *19*, 537–539 (1918): P_3B Elektrotech. Z. *39*, 269 (1918). B Electrician *81*, 141 (1918).

DUMAS, JEAN BAPTISTE ANDRÉ

Born July 15, 1800, at Alais in the department of the Gard in southern France; died April 11, 1884, at Cannes, in the Maritime Alps, France, age 84.

This great French chemist, investigator, teacher and administrator, after an initial brief apprenticeship to the local apothecary, travelled on foot to Geneva, Switzerland, where he attended the lectures of Pictet (physics), de la Rive (chemistry) and de Candolle (botany). Before the age of 21 he established the presence of iodine in carbonized sponges (then used as a specific against goitre), devised the alcoholic solution of iodine-potsssium iodide now known as tincture of iodine, and with J. L. Prevost engaged in physiological research one result of which was the first recognition of the function of the kidney in the elimination of urea. These and other works of Dumas attracted the attention of Baron A. von Humboldt, who persuaded him to remove (1823) to Paris, where he resided for the rest of his life. Here he was cordially received by such distinguished savants as Ampère, Arago, Biot, Gay-Lussac, La Place, Thenard, Vauquelin and others including the distinguished geologist Alexander Brogniart, whose daughter he married (1826).

Dumas became (1823) repetiteur for Thenard's lectures at the École Polytechnique and also lecturer at the Athenaeum succeeding Robiquet. With T. Olivier and E. Peclet he founded (1828–9) the Central School of Arts and Manufactures of which he was for many years professor of chemistry and in whose fiftieth anniversary celebration he participated. He soon after (1832) succeeded Gay-Lussac at the Sorbonne, shortly (1835) followed Thenard at the École Polytechnique

and only a little later (1839) took the place of Deyeux at the École de Medecine. Thus before the age of forty he filled successively and for some time simultaneously all the important professorships of chemistry in Paris except that of the College of France. Even there he delivered (1836) his famous lectures on the history of chemical philosophy while temporarily supplying in place of Thenard.

Dumas' contributions to science include many still of constant service to chemists. He developed [Ann. chim. (2) *47*, 198–213 (1831)] the well-known Dumas method quantitative determination of nitrogen and a simple procedure [Ann. chim. (2) *33*, 337–391 (1826)] for determination of vapor densities and, therefore, molecular weights of volatile compounds. With Peligot he first (1834) recognized methyl alcohol as one of the products of distillation of wood and gave it the name "wood alcohol." A year later Dumas discovered isoamyl alcohol and subsequently developed the concept of homologous series. With J. S. Stas he first [Ann. *35*, 129–173 (1840)] employed alkali fusion on organic compounds. Dumas discovered that nitriles could be obtained from amides by dehydration with phosphorous pentoxide. He assigned the name propionic acid to the compound previously known as metacetic acid. His studies on the substitution of chlorine for hydrogen in organic molecules, a topic to which his attention was directed by an incident at the Tuileries in which suffocating fumes developed from candles which had been bleached with chlorine, played an important part in the development of the theory of chemical types.

Dumas early (1832) was elected to the Academy of Science, became its perpetual secretary (1868), and was named (1875) to the French Academy to succeed Guizot. He was elected (1840) to the Royal Society of London, was its Copley Medallist in 1843, and delivered (June 17, 1869) at the Royal Institution in London the first of the Faraday Memorial Lectures of the British Chemical Society. This lecture does not appear in any of the Society's periodicals but is given in its special Jubilee Volume (1896), [also in Chemical News *20*, 1–7 (1869)].

P_1B Nature *21*, Special Issue of Feb. 6, 1880, i–xl (Scientific Worthy Series): P_1B Bull. soc. chim. (2) *42*, 549–559 (1884); (2) *45*, 4–64 (1886) (incl. bibliog. of 853 items): B Compt. rend. *98*, 933–945 (1884): P_1B Ber. *17*, Referate 629–760 (1884); *17*, 947–949 (1884): B Proc. Roy. Soc. (London) *37*, x–xxvii (1884) reprinted also in J. Chem. Soc. *47*, 310–323 (1885): B Chemistry and Industry *22*, 333–335 (1944): B Pop. Sci. Monthly *18*, 257–261 (1880): B Proc. Am. Acad. Arts Sci. *19*, 545–556 (1884): P_3B J. Chem. Education *15*, 253–259 (1938).

WÖHLER FRIEDRICH

Born July 31, 1800, at Escherscheim, near Frankfort-on-the-Main, Germany; died September 23, 1882, at Göttingen, Germany, at age 82.

This Nestor of German chemists initially directed his study toward medicine and after beginning (1820) such a course at Marburg transferred the next year to Heidelberg where (1823) he indeed received the degree of doctor of medicine, surgery and obstetrics. However, Leopold Gmelin, whose fame in chemistry had attracted Wöhler to Heidelberg, persuaded him to abandon medicine for chemistry and he spent a year (1823–4) at Stockholm in the laboratory of Berzelius with whom he subsequently maintained a lifelong friendship. Wöhler himself fifty years later published [Ber. *8*, 838–852 (1875)] a charming account of his journey to Sweden and his experiences with Berzelius. His first academic post (1825–1831) was at the Municipal Trade School (Gewerbeschule) at Berlin from which he published [(Pogg.) Ann. Physik *12*, 253–256 (1828)] his epoch-making synthesis of urea. The next four years (1831–1835) he occupied a similar position at Cassel, where he was succeeded (1836) by Bunsen. Most of Wöhler's professional life, however, was spent at Göttingen where succeeding Stromeyer he occupied the chair of chemistry for 46 years (1836–1882) and attracted a stream of students from all over the world. These disciples included such subsequently distinguished American chemists as S. M. Babcock, H. C. Bolton, J. C. Booth, C. F. Chandler, C. A. Goessmann, J. W. Mallet, S. P. Sadtler, E. F. Smith and Ira Remsen [for a complete survey of Wöhler's American students see J. Chem. Education *21*, 158–170 (1944); for an account by E. F. Smith of his experiences as Wöhler's student see J. Chem. Education *5*, 1554–1557 (1928)]. His monument at Göttingen [see P_1 Ber. *23* (Referate), 829–851 (1890)] commemorates the long and distinguished services to chemistry of a scientist who never attended any formal course of chemical instruction.

Wöhler's most important contribution to science was his discovery of the conversion of ammonium cyanate to urea. This demolished the theory that for the formation of organic compounds some "vital force" was necessary and introduced the concept of the rearrangement of atoms within a molecule. [For the complete history of this discovery see Ber. *61-A*, 3–7 (1928) and for its contemporary reception see J. Chem. Education *5*, 1538–1553 (1928)]. Other important organic contributions by Wöhler include his recognition (1832 with Liebig) of the benzoyl radical, his discovery of amygdalin (1837) and hydroquinone (1848). He was, however, equally distinguished as an inor-

ganic chemist for he first isolated metallic aluminum (1827), beryllium (1828), and yttrium (1828), discovered (1832) the dimorphism of arsenious acid and antimony oxide and first (1862) prepared calcium carbide. During his lifetime he published some 320 papers.

Wöhler was primarily concerned with the facts and took little part in the speculative theories which during his lifetime so vigorously engaged the attention of Berzelius, Dumas, Liebig and many others. In one famous instance, however, he published [Ann. *33*, 308–310 (1840)] under the pseudonym of S. C. H. Windler a brief but brilliant satire of the type theory which has become very famous [for translation and discussion see J. Chem. Education *7*, 633–636 (1930)].

In addition to his stay (1823–4) at Stockholm Wöhler later visited France (1833) and England (1835). He served as president of the German Chemical Society and was elected (1854) to the Royal Society of London of which he later (1872) was Copley Medallist.

P_1B Ber. *15*, 3127–3290 (1882) (incl. bibliog.): B Ber. *8*, 989–990 (1875), *13*, 1153–1154 (1880); *15*, 2285–2888 (1882), *65-A*, 88–94 (1932): B Proc. Roy. Soc. (London) *35*, XII–XX (1883): P_1B J. Chem. Education *5*, 1536–1538 (1928): B J. Chem. Soc. *43*, 258–263 (1883): B Nature *26*, 578–579 (1882): B Pop. Sci. Monthly *17*, 539–551 (1880): B Am. Chem. J. *4*, 289–292 (1882–3): B Proc. Am. Acad. Arts Sci. *18*, 463–465 (1882–3).

HENNIGER, ARTHUR RODOLPHE MARIE

Born Aug. 7, 1850, at Oberursel, Nassau, Germany; died Oct. 4, 1884, in Paris at age 34.

Although born in Germany Henniger was a French citizen. At age 17 he entered Wurtz's laboratory, where his exceptional education and manipulative skill quickly attracted attention. He soon became Wurtz's private assistant, then his collaborator. After his medical doctorate (1878) with a dissertation on peptones, Henniger became professor on the medical faculty of the École de Medicine of the University of Paris, sometimes substituting for Wurtz in delivering lectures.

The now well-known conversion of glycerol to allyl alcohol by heating with oxalic acid was worked out by Henniger in collaboration with Tollens [Ann. *156*, 134–174 (1870)]. Subsequently Henniger developed [Ann. chim. (6) *7*, 211–233 (1886)] a general method for the partial reduction of polyhydric alcohols by means of formic acid. With Vogt he achieved the first synthesis [Ann. chim. (4) *27*, 129–144 (1872); Bull. soc. chim. (3) *17*, 541–550 (1872); Ann. *165*, 362–376 (1873)] of orcinol (5-methylresorcinol). By most students of organic chemistry, however, his name is associated with the LeBel-Henniger distillation column [Compt. rend. *79*, 480–483 (1874)].

B Bull. soc. chim. (3) *42*, 547–549 (1884): B Ber. *17*, 2812–2813 (1884): B Rév. sci. *34*, 632–633 (1884): B Ann. chim. applicata *1*, 167 (1885).

RICHET, CHARLES ROBERT

Born Aug. 26, 1850, in Paris, France; died Dec. 4, 1935, in Paris, age 85.

This French physiologist, later (1913) recipient of the Nobel Prize in physiology and medicine, was the son of the well-known surgeon, Alfred Richet. The youth studied medicine in Paris receiving M.D. (1877) and Sc.D. in physiology in 1878. He then became associated with the staff of the University of Paris, where for forty years (1887–1927) he served as professor of physiology. He was elected (1899) to the Academy of Medicine and later (1914) to the Academy of Sciences of which latter he subsequently (1933) served as president. Richet was the author of numerous physiological treatises including (1895–1906) a four-volume dictionary of physiology, and for seventeen years (1917–1933) served as co-editor of the French "Journal de Physiologie et Pathologie Génerale."

One of the amazing aspects of his career is the variety of subjects to which he made fundamental contributions. He was physiologist, pathologist, bacteriologist, psychologist, engineer, statistician, poet, dramatist, novelist, playwright and much else. He became deeply interested in psychical investigation and an English translation of his recorded experience in this field appeared in 1923 under the title, "Thirty Years of Psychical Research."

Richet's doctoral thesis (1878) included the first demonstration of the presence of hydrochloric acid in the gastric juice. Later he showed that respiratory exchange is proportional to the surface of the body, thus establishing what is sometimes known as Richet's and Rubner's law. Other physiological topics to which he contributed included studies of the function of brain and nerves and of the production of heat in the animal body. In collaboration with Hericourt, Richet also carried out some of the earliest work on serum therapy, including on December 6, 1890, at the Hotel-Dieu in Paris, the first injection of serum to a human patient.

Richet's most important scientific contribution, however, was his discovery [Compt. rend. soc. biol. *54*, 170–172 (1902)] with P. J. Portier, of the phenomenon of hypersensitivity for which he coined the name "anaphylaxis" but which is now more commonly designated as allergy. While studying the action of the poison of sea anemones, Richet observed that dogs which without any inconvenience had withstood an intravenous injection of a minimal dose were unable a few

days later to survive a second but weaker injection administered in the same way. Since this second treatment was insufficient to kill a fresh animal, the conclusion was drawn that the effect of the first dosage was to produce an increased sensitivity to the action of the second. Subsequently, Richet showed that nearly all substances having this effect are proteins, and established a diagnostic test for certain ones based upon the fact that the hypersensitivity produced is specific for the protein first injected. Richet's work on anaphylaxis was recognized by the award of the Nobel Prize in physiology and medicine for 1913 and forms the basis for our present conception of the causes of hay fever, asthma, certain skin eruptions, and many other allergic conditions.

B Nature *136*, 1017–1018 (1935): P_3B Lancet *1935*, II 1380–1381: B Brit. Med. J. *1935*, II 1160–1161: P_3B Presse Méd. *43*, II 2043–2045 (1935): B Compt. rend. soc. biol. *120*, 927–929 (1935): P_3B Paris Médical *98*, 541 (1935): P_3B Riforma méd. *42*, I 621–622 (1926); *52*, I 24, 27 (1936) (Italian).

HOFMEISTER, FRANZ

Born Aug. 30, 1850, at Prague, Austria; died April 26, 1922, at Würzburg, Bavaria, Germany.

This Austro-German physiological chemist, the son of a distinguished Bavarian physician, showed even as a young medical student at the University of Prague a strong inclination toward the biological applications of chemistry. After H. Huppert came to Prague as professor of medical chemistry, Hofmeister served as his first assistant. Upon the establishment of the Prague Institute for Experimental Pharmacology Hofmeister became assistant professor (1883) and quickly associate professor (1885) of this institution. After thus spending 24 years (1872–1896) in Prague he was called to Strasbourg to succeed Hoppe-Seyler in the Chair of Physiological Chemistry, where the second great period (1896–1919) of his life was spent. For his last few years (1918–1922) he held a similar place in the Pathological Institute of the University of Würzburg.

Hofmeister's interests extended over a vast range of physiological and biochemical topics and a bibliography [Ergeb. Physiol. *22*, 39–50 (1923)] comprising both his independent papers and those of and with his numerous students includes 378 entries. His researches on amino acids and proteins led to views on the amide linkages of the latter which subsequently found support in the synthetic work of Emil Fischer and the analytical studies of A. Kossel. Hofmeister was the first [Z. physiol. Chem. *14*, 165–172 (1890); *16*, 187–191 (1892)] to obtain crystalline protein (egg albumin). He made many studies of

animal metabolism and coined the term "hunger diabetes" [Arch. exp. Path. Pharmakol. *26*, 355–370 (1890)] referring to the fact that fasting animals show glycosuria. He anticipated the modern trend toward physicochemical approaches to biology and his work on the effect of salts in coagulation of lyophilic colloids [Arch. exp. Path. Pharmakol. *24*, 247–260 (1888)] is memorialized in the term Hofmeister series.

P_1B Ergeb. Physiol. *22*, 1–31 (1923): B Biochem. Z. *134*, 1–2 (1923): B Arch. exp. Path. Pharmakol. *95*, i–v (1922): B Klin. Wochschr. *1*, 1974–1975 (1922).

GOLDSTEIN, EUGEN

Born Sept. 5, 1850, at Gleiwitz, Upper Silesia, Germany; died Dec. 25, 1930, in Berlin, Germany.

This German physicist was a pioneer in the study of electric discharge through gases at reduced pressure. He studied (1869–1870) at the University of Breslau and subsequently became the first student of von Helmholtz in the newly established physics laboratory at the University of Berlin from which he received his doctorate in 1881. The following fifty years of his life were largely spent in Berlin, first as a physicist with the physical laboratory and later at the Potsdam Observatory. His first scientific paper (1876) was followed by a long series dealing mainly with the production, characteristics and behavior of cathode and anode rays. Goldstein is of most interest to chemists, however, because of his discovery [Sitzungsber. Preuss. Akad. Wiss. *1886*, 691–699] of "canal rays." Twelve years later this paper was reprinted in a more accessible journal [(Wiedemann's) Ann. Physik. *64*, 38–48 (1898)] where by an odd coincidence it immediately followed in the same issue Roentgen's announcement of the discovery of X-rays. Goldstein's original paper together with several subsequent communications on the same topic have now been made easily available under the title "Kanalstrahlen" as No. 231 (1930) of the well-known series collectively known as Ostwald's "Klassiker der Exakten Wissenschaften."

In contrast to the cathode rays established (1869) by J. W. Hittorff following certain earlier but tentative observations by Plücker and subsequently recognized to be streams of electrons leaving the cathode, Goldstein's observed his "canal rays" to move in the opposite direction. By using a cathode perforated with small holes some of the rays passed through these orifices and produced luminous streamers which suggested canals. Goldstein noted that this radiation was not appreciable influenced by magnetic forces able to produce large deflections of the cathode rays, but twelve years later (1898) Wien discovered that under suitable magnetic conditions they were deflected in a direction

opposite to that of cathode rays and hence carried positive charges. Subsequently the term canal rays was gradually replaced by that of "positive rays" suggested by J. J. Thomson. Subsequent studies of positive rays by W. Wien, J. J. Thomson, and especially F. W. Aston led to the development of the mass spectrograph with which the ratio e/m of charge to mass can be measured with great accuracy. Since such determinations led to the discovery of isotopes, Goldstein's initial discovery of "canal rays" may be considered the foundation of an important aspect of modern chemical physics.

P_1B Naturwissenschaften *8*, frontispiece to Heft 36, 717–725 (1920) (incl. bibliog.): P_3B Physik. Z. *31*, 873–876 (1930): B Naturwissenschaften *18*, 773–776 (1930): B Forschungen u. Fortschr. *6*, 330 (1930); 7, 46 (1931): B Verhandl. deut. physik. Ges. *12* (1931).

LASSAIGNE, JEAN-LOUIS

Born Sept. 22, 1800, in Paris, France; died March 18, 1859, in Paris.

This obscure French chemist studied under Vauquelin, became professor of industrial chemistry at a trade school in Paris, then professor of chemistry (1828) at the Alfort Veterinary School and finally (1854) chemist for the Departement de la Seine. Although the Royal Society Catalogue of Scientific papers indicates his publication of nearly 200 papers, recorded information on his career is conspicuously absent.

His name, however, is well known to organic chemists because of his discovery of a method for the detection of nitrogen in organic compounds, variations of whose fundamental principle are still in constant use. More than 100 years ago Lassaigne discovered [Compt. rend. *16*, 387–390 (1843); Ann. *48*, 367–368 (1843); J. prakt. Chem. (1) *29*, 148–152 (1843)] that upon fusion with metallic potassium organic matter containing nitrogen gave potassium cyanide, the detection of which by simple conversion to ferric ferrocyanide (Prussian Blue) thus indicated the original presence of nitrogen in the organic sample. The use of metallic sodium in place of potassium appears to have been introduced by O. Jacobsen [Ber. *12*, 2318 (1879)]. Various other minor changes in the method have been reviewed by S. H. Tucker [J. Chem. Education *22*, 212–215 (1945)] but the essence of the test stands substantially unchanged.

LECHATELIER, HENRY LOUIS

Born Oct. 8, 1850, in Paris; died Sept. 17, 1936, at Miribel-les-Echelles near Grenoble, in the Dept. Isère, southeastern France, at age 86.

LeChatelier, eldest of six children, and whose father maintained close friendship with Dumas, Chevreul, Siemens, and especially Sainte-

Claire Deville, entered (1869) the École Polytechnique. His studies were interrupted by the siege of Paris but after finishing (1871–3) at the École des Mines he spent several years in government engineering work. At age 27 (1877) he returned to the School of Mines in the chair of general chemistry which a decade later (1887) he exchanged for that of industrial chemistry and metallurgy retaining this post until 1919. From 1897–1907 he also served as professor of inorganic chemistry at the College de France succeeding Schutzenberger, and from 1907 occupied the chair of general chemistry at the Sorbonne succeeding Moissan.

LeChatelier, a prolific writer with interests in many fields, published over 500 articles and books. An initial interest in the setting of cement developed further in his doctoral thesis (1887), his first book (1903) and its subsequent English translation (1905) has formed the basis of present knowledge in this field. Confronted in these studies with the necessity for improving on contemporary methods of high temperature measurement, he devised the platinum vs. 90 platinum/10 rhodium thermocouple which today comprises the international standard. His treatise (1900) on measurement of high temperatures, especially as translated and revised by G. K. Burgess (1912) comprised a landmark. He made fundamental studies of alloys both with respect to chemical constitution (including intermetallic compounds, solid solutions, and allotropic modifications) and physical structure. He devised numerous new methods and instruments including a revolutionary form of metallographic microscope. He founded (1904) the Revue de Metallurgie and served (1904–1910) as its first editor. Earlier concern with explosions of mine gases interested him in extensive studies of chemical equilibria which culminated in his expression of LeChatelier's Principle (i. e., that a system tends to change so as to minimize the effects of an external disturbance) by which he is best known to students of chemistry.

For LeChatelier's public service and impressive honors more extended treatments must be consulted. He was elected (1907) to the French Academy of Science succeeding Moissan and (1913) a foreign member of the Royal Society of London.

P_1B Obit. Notices, Fellows Royal Society (London) *2*, 251–259 (1938): P_1B J. Chem. Soc. *1938*, 139–150: P_1B J. Chem. Education *7*, 2537–2539 (1930): P_1B Rév. mét., Special No., 1–160 (Jan. 1937) (incl. bibliog. and many portraits): B Bull. soc. chim. (5) *4*, 1557–1611 (1937) (incl. bibliog.): B Ber. *69–A*, 228 (1936); *72-A*, 122–127 (1939): P_2B J. Chem. Education *8*, 442–461 (1931): P_3B Bull. Am. Ceram. Soc. *16*, 155–163 (1937); bibliog. in Ceram. Abstracts *16*, 316–322 (1937): P_3 J. Chem. Education *11*, 510 (1934); *14*, 555–560 (1937); *15*,

289–290 (1938): P_3B Naturwissenschaften *24*, 769–770 (1936): B Chimie et Industrie *36*, 669–672 (1936): B Compt. rend. *203*, 551–552 (1936): B Nature *138*, 711–712 (1936): B Mineralog. Mag. *25*, 296 (1938–40): B J. Iron and Steel Inst. *134*, (2) 637P–640P (1936): B Zentr. Mineral. Geol. Abt. A, *1937*, 57–59: P_3B Chem. Weekblad *33*, 775–776 (1936) (Dutch): B Roczniki Chem. *17*, 53–60 (1937) (Polish).

DOEBNER, OSKAR GUSTAV

Born Nov. 20, 1850, at Meiningen, Thüringen, Germany; died March 28, 1907, at Marseille, France, during a vacation trip.

This pioneer of organic synthesis, one of seven children, was at first uncertain of which field of science he would pursue. After completing the Gymnasium of his native town, he began (1869) at Jena the study of botany. This was continued (1869–1870) in Munich and accompanied both by zoology and by inorganic chemistry under Liebig. After active service in the Franco-Prussian War he resumed his studies by enrolling at Leipzig where he attended lectures by Leuckart in zoology, by Credner in geology, and by Kolbe in organic chemistry. These experiences seemed to settle his doubts in favor of organic chemistry and he next (1872–1873) obtained his doctorate at Tübingen with a dissertation on derivatives of biphenyl under Fittig.

Doebner then became (1874–1875) an assistant to Otto at Braunschweig, and afterward (1875–1879) occupied a similar position with A. W. Hofmann at Berlin, where (1879–1884) he also served as privat dozent. For some 23 years he taught at the University of Halle, first (1884–1899) as assistant professor, then (1899–1907) as associate professor of chemistry and pharmacy.

Doebner's first important contribution to chemistry was the discovery [Ber. *11*, 1236–1241, 2274–2277 (1878)] of the condensation of benzotrichloride with dimethylaniline to give the important dyestuff Malachite Green (E. C. I. No. 657). It should be noted, however, that the preparation of this dye from benzaldehyde and dimethylaniline followed by oxidation of the resultant leuco compound had been noted by Otto Fischer [Ber. *10*, 950–952, 1624–1625 (1877)] in the preceding year. The analogous but simpler dye known as Doebner's violet was a later development [Ber. *15*, 234–239 (1882)] and never became a commercial material.

His second important development, carried out in collaboration with W. von Miller at Berlin, was the general synthesis of α-substituted quinolines now generally known as the Döbner-Miller reaction. By this means these workers achieved [Ber. *14*, 2812–2817 (1881)] the synthesis of quinaldine (2-methylquinoline) and subsequently elaborated the method in a long series of publications. A variant in which

aromatic primary amines condense with aldehydes and pyruvic acid to yield derivatives of quinoline-4-carboxylic acid (cinchoninic acid) is known as Doebner's pyruvic acid method [Ann. *242*, 265–300 (1887)]. Many other variations and extensions of the Doebner-Miller reaction have since been studied.

Other advances due to Doebner include his discovery of the permanganate oxidation of phenol to mesotartaric and oxalic acids [Ber. *24*, 1753–1757 (1891)], his synthesis of α-alkyl-β-naphthocinchoninic acids by condensation of aldehydes with pyruvic acid and β-naphthylamine and its application to the characterization of aldehydes [Ber. *27*, 352–354, 2020–2030 (1894)] especially those from essential oils, his proof of the structure [Ber. *23*, 2372–2377 (1890); *27*, 344–351 (1894)] and subsequent achievement of the synthesis [Ber. *33*, 2140–2142 (1900)] of sorbic acid (hexadien-2,4-oic acid), and his synthesis [Ber. *35*, 1147–1148 (1902)] of muconic acid (hexadien-2,4-dioic acid 1,6).

B Ber. *40*, 1485, 5131–5140 (1907) (incl. bibliog.); P_3B Z. Angew. Chem. *20*, 736 (1907).

HESS, GERMAIN HENRI

Born Aug. 7, 1802, in Geneva, Switzerland; died Dec. 12, 1850 (New Style) in St. Petersburgh.

Hess, one of the foremost physical chemists of Russia during the early nineteenth century, became (1832) professor of chemistry and inspector of mining cadet corps, one of the founders (1828) of the Technological Institute of St. Petersburgh, and a member (1834) of the Russian Academy of Science. His textbook, "Fundamentals of Pure Chemistry," (1831) passed through seven editions (last in 1849). With the collaboration of P. G. Sobolevskij, S. J. Nečaev and M. S. Soloviev he devised a rational Russian chemical nomenclature still employed. Internationally he is best known for his work (1836–1841) on heats of chemical reactions, compactly assembled (1890) by W. Ostwald as the ninth of his famous series, "Classics of the Exact Sciences," and familiar to chemists as Hess' law of constant heat summation.

P_3B J. Chem. Education *11*, 228 (1934).

GOODYEAR, CHARLES

Born Dec. 29, 1800, at New Haven, Connecticut; died July 1, 1860, in New York City.

This American discoverer of the vulcanization of rubber was the son of a New Haven hardware manufacturer and merchant. At age 17 he was placed with the hardware firm of Rogers Brothers in Phila-

delphia to learn this trade and subsequent y went into partnership with his father at Naugatuck, Connecticut. In 1824 he married and eventually acquired a family of six including two sons who later made independent names for themselves; the older, Charles Goodyear, Jr. (Jan. 1, 1833–May 22, 1896) founded the Goodyear Shoe Machinery Company which became one of the initial components of the present United Shoe Machinery Corporation; the younger, William Henry Goodyear (April 21, 1846–Feb. 19, 1923) was of artistic temperament, became a well-known archeological and architectural scholar and for 33 years (1890–1923) was head of the department of fine arts of the Brooklyn Institute of Arts and Sciences.

In 1834 while on a business trip to New York Goodyear chanced to notice in a display of the Roxbury India Rubber Company a rubber life preserver whose mechanical valve he felt that he could improve. Struck by the ingenuity displayed in this respect, the agent confided to him the difficulties faced by the company in attempting to overcome the tendency of their rubber products to soften in summer and to become brittle in winter. Despite his lack of any prior experience with or chemical knowledge of rubber, Goodyear forthwith threw himself with fanatical devotion into a protracted attempt to solve this problem.

After several years of fruitless endeavor he employed early in 1838 a Nathaniel Hayward (1808–1865) who during prior experience with a rubber company had found that by mixing raw rubber with sulfur and exposing the surface to sunlight, the objectionable adhesiveness of the surface was permanently removed. This solarizing process did not, however, have any influence upon the unfortunate temperature characteristics and could be utilized only on thin surfaces. Recognizing an advance, however, Goodyear persuaded Hayward to patent his method and then bought the patent for $200. Early in 1839 at his house in Woburn, Mass., while conferring with a group regarding this mixture of sulfur and gum rubber, Goodyear accidentally dropped his sample on a hot stove, where to his astonishment the material failed to melt. This discovery of what he designated as vulcanization of rubber eventually culminated on June 15, 1844, in the issuance of U. S. Patent 3,633. An attack on the validity of this patent by one Horace H. Day led to a famous trial at Trenton, N. J., in which the astute Daniel Webster, for the highest fee ($25,000) ever paid an American attorney up to that time, defended Goodyear against Rufus Choate representing Mr. Day. A decision in favor of Goodyear was handed down on Sept. 28, 1852.

Goodyear published (1853–1855) a two-volume treatise entitled, "Gum-elastic and its varieties, with a detailed account of its applications and uses and of the discovery of vulcanization." It was bound

in India rubber and a few copies were actually printed on rubber tissue. A complete facsimile reproduction of both volumes of this rare work, together with a similar copy of Thomas Hancock's "Caoutchouc or India-Rubber Manufacture in England" (1857), the three works together comprising one bound volume of some 925 pages, was distributed as a souvenir of the Centennial celebration of the discovery of the vulcanization of rubber at the 100th National Meeting of the American Chemical Society in Boston, Mass., in 1939. [For a further account of this observance see Ind. Eng. Chem. *31*, 1189–1217 (1939) and India Rubber World *101*, No. 1, 89–96 (1939)].

P_3B Ind. Eng. Chem. *31*, 1191–1192 (1939): P_3B J. Chem. Education *7*, 1788–1801 (1930): P_3B India Rubber World *101*, No. 1, 48–49 (1939): P_1B Pop. Sci. Monthly *53*, 697–700 (1898): B Gummi Ztg. *38*, 173–174 (1923): B Dict. Am. Biog. *7*, 413–415 (1931): P_1B Natl. Cyclop. Am. Biog. *3*, 86 (1893).